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Leaks in Fruit Containers.

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"The Tin Factory, in what might be termed its trial run, was an expensive experiment. In a total of 107,191 2½-lb. cans made by this Factory, and used in canning, 15,408 were found during processing to be leaky, and of those manufactured and purchased 5,013 developed leaks in the warehouse. Besides these, 6,959 were spoiled in manufacture, and 4,773 faulty cans were found amongst those purchased. These make a total loss of 14.7 per cent. of the 2½-lb. cans used. Further, of 3,140 No. 10 cans purchased, there was a loss of 23 per cent. through leaks. It is still a controversial point as to where the fault lies, but in the light of cold fact, wherever the fault, considerable monetary loss has been the result."

—State Industrial Undertakings (New South Wales) Report of the Auditor-General, 1918, p. 77.

The quotation is interesting in showing the heavy loss that may occur in a cannery, even with the most improved plant, for that at Leeton, on the Murrumbidgee Irrigation Area, is of the most modern type. It may be that much of the loss was caused by the faulty closing of the containers, for that is the weak point about the preservation of fruit and vegetables. Unless solder is used, no machine can fit on a lid and make the container absolutely air and water tight, that is, make it equivalent to a hermetically-sealed vessel. There is always a weakness where metal joins metal with a non-metallic luting material at the points of contact. The internal pressure developed during the processing finds out the weak places, and there is leakage, with its attendant troubles.

My attention was called to the irregularities in the canning process by one of our leading fruit-canners, who desired to know the reason for the "springing" of his tins of preserved fruit. Some time after processing, the tins, which normally should have concave ends, indicating a partial vacuum within, become bulged at one or both ends, clearly showing that internal fermentation has occurred. Such containers are condemned as containing food unfit for human consumption, as doubtless they do. Putting them through the boiler again, that is "reprocessing" them, does not do much good, as they may become worse, and the reason for this becomes evident when the cause of the "springing" is understood.

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In processing pears, for example, the fruit is pared, halved, cored, washed, and filled into the empty containers, which are placed upon a travelling belt. A girl fills them with boiling syrup up to anything from half to a quarter of an inch from the top. Then they pass to the closing machine, which turns the lid on the cylindrical wall of the container by forming a double interlocking hook. The tin goes to the boiler, where it is cooked. On emergence from the boiler, the tins are stacked on the floor of the cannery until they are sufficiently cold to enable them to be taken to the storage room, where they are arranged in tiers. After a time many of them begin to ooze syrup from the junction around the top or bottom, and the leakage may continue, or it may stop, and the syrup hardens, forming a lute of dried syrup. It is among these that the springers are afterwards found.

The "springing" results from the production of gas inside the tin, and, as this is unable to escape, the top is forced outwards, and the pressure may be so great as to cause the syrup to be forced out through the junction of the lid with the side of the tin. The gas must be produced by the action of micro-organisms, unless it be by the activity of fruit enzymes. The latter is unlikely, partly because of the heat to which the contents have been subjected during the cooking process, and partly because, if they were the agents, every tin would be a springer. The closed tins are put through a boiler, and are in the boiling water for sixteen minutes, which, according to laboratory experiments,* is quite enough to thoroughly pasteurize the contents. One should, therefore, look to the subsequent treatment for the cause of the trouble. We found that the active organisms were yeasts, and as these could not have persisted through the cooking process, it follows that they must have gained entry afterwards. The most plausible suggestion is that the lids are not absolutely sealed. Previous to fixing on, the margins of the lids are painted or dusted with a composition, which packs the space between the flanges when the lid is turned over the container side. The composition seems to vary. It consists sometimes of flour, dextrin, and finely powdered cork, at others of flour, dextrin, and rice starch. It does not form an impervious lute, possibly because the starch and flour are jellified by the hot water, and blown out by the internal pressure, so that the cork alone remains. As nearly every second tin of pears shows signs of leakage in the storage room, it is evident that the closure of the tins is by no means perfect. A rubber composition is used by some canners, and this should make a more efficient lute.

Since the closing is so imperfect, one is justified in presuming that, as the can cools down and the contained steam becomes condensed, there is an inward pressure or vacuum, and a certain amount of air is drawn inside the tin. This is the root of the trouble. Any living microbe, yeast, or mould which chances to be in the air that is sucked in will destroy the sterility of the contents. If it is a yeast, much will depend upon its power of causing a fermentation of the syrup. Some yeasts produce little gas, others are active fermenters, and will produce "springers." If the organism is an acid-producer, the tin will become a "sour," which may not be of any industrial consequence. The already acid syrup may, with a little more acidification, which is recognisable only by the expert, become so unsuitable to the microbe that it is killed off, and the trouble does not become excessive. It is entirely a matter of chance as to whether any microorganism gets in, or that the organism, getting in, can injure the contents. In a cannery, where so much fruit is being dealt with, one would expect the yeasts that do obtain entry to be fruit yeasts, that is, the kind known as wild yeasts. It was

* "The 'Springing' of Tins of Preserved Fruit," By W. W. L'Estrange and R. Greig-Smith, Proc. Linn. Soc., New South Wales. 1918, p. 409.

with some surprise, therefore, that we found the yeasts in the majority of the tins to be of the cultivated or brewery type. The anomaly was, however, explained when we learned that next door to this particular cannery there was a factory actively engaged in producing ginger beer. Doubtless they were using the brewery type of yeast, and in sufficient amount to charge the air of the cannery.

While the reason for the springing can be traced to air accompanied by microscopic life being sucked into the tin while cooling, experience tells us that there is something more in it than can be explained by this theory. The "fly in the ointment" is this, that in the storage room about every second tin of pears shows signs of leaking, about every tenth tin of plums, and with peaches, apricots, and other stone fruits, the leaks are few in number. It is possible that the juice of pears has a greater solvent action upon the starch-luting of the container lid than other fruit juices. The subject is of interest, but there can be no doubt about the entry of life into the future springer subsequent to the cooking, and subsequent to the moment when the tins have cooled down to 170° F., or a little lower. The critical time begins when the tins are cold enough for the incoming yeast to be able to exist. Thus there is an appreciable interval between the time that the tins leave the cooker and the entry of potentially active micro-organisms.

The fault is not always with the lid itself. Sometimes the tin plate is spongy, and the syrup oozes through the microscopic holes; at other times the solder cementing the cylindrical wall of the container splits when the metal is turned in the closing machine. Again, there may be a small hole left at the extreme end of the seam, where the metal has been cut to give a single thickness of metal for bending into the hooked joint. The weakness about the process is in the closing of the container.

The remedy is theoretically simple. From the time that the tins are at 170° F. until they are cold enough to work they should be in a sterile atmosphere. Then the edges of the tops and bottoms should be painted with a lacquer to close any microscopic opening. It is not a difficult proposition, and should be easy to accomplish in any cannery.

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